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ABSTRACT

This study compared the reading comprehension abilities of learning disabled (LD) students with the performance of both their age-peers and their reading-level peers. Subjects were 16 seventh- and eighth-grade LD students, 16 normal achieving eighth graders, and 16 normal achieving fifth graders. To assess the use of prior knowledge under varying conditions, reading passages included both familiar and unfamiliar topics. All passages tested inferential reading ability, since the answers to test questions could be inferred from content, but were not explicitly stated. Inferential tasks are most appropriate for use in reading research, since all reading tasks ultimately involve a search for meaning, and meaning is often implicit. Subject-activation and experimenter-activation of prior knowledge were also compared. Results indicated that all groups benefited from experimenter-activation of prior knowledge, but benefits were most noteworthy for LD subjects and when passage topics were unfamiliar. The LD subjects were strikingly similar in performance to their reading-level peers, as against their age-peers. (Six tables of data are included and 27 references are attached. Appendixes include 12 additional tables of results.) (Author/MG)

The Effects of Prior Knowledge and Schema Activation Strategies on the Inferential Reading Comprehension Performance of Learning Disabled and Nonlearning Disabled Children

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Abstract

The present study compared the reading comprehension abilities of learning disabled (LD) students with the performance of **both** their age-peers and their reading-level peers. Reading passages included both familiar and unfamiliar topics, so as to assess the use of prior knowledge under varying conditions. But all passages tested inferential reading ability, since the answers to test questions could be inferred from content, but were not explicitly stated. Inferential tasks are most appropriate for use in reading research, since all reading tasks ultimately involve a search for meaning, and meaning is often implicit. Subject-activation and experimenter-activation of prior knowledge were also compared. All groups benefited from experimenter-activation of prior knowledge, but these benefits were most noteworthy for LD subjects and when passage topics were unfamiliar. The LD subjects were strikingly similar in performance to their reading-level peers, as against their age-peers. Thus, the finding sheds some light on the nature of learning disabilities. Implications for instruction are explored.

The Effects of Prior Knowledge and Schema Activation Strategies on the Inferential Reading Comprehension Performance of Learning Disabled and Nonlearning Disabled Children

An interactive view of reading suggests that several factors are critical to the reading process. The literature indicates that the reader constructs the meaning of written discourse through the interaction of various sources of knowledge, including: the reader's previously acquired knowledge of the topic, knowledge of text structure, purpose for reading, and so on. Internal factors influencing the reading process may include the reader's knowledge base, the reader's cognitive resources, the reader's viewpoint and the purpose for reading (Samuels, 1983). Factors external to the reader must also be considered in terms of their impact on the reading process. These factors include: "physical characteristics of the text, the style and readability of the text, and its subject matter, as well as the goal or direction imposed on the reader by an external source" (Samuels, 1983, p. 261). Factors **both internal and external** to the reader interact to influence the ease or difficulty with which text is comprehended.

With acceptance of an interactive view of reading comes recognition that there may be many sources of "reading disability." In a review of research on reading disability, Lipson and Wixson (1986) point out that from the mid-1920s to the mid-1970s "within the reader" deficit models of reading disability dominated the literature. But beginning in the mid-1970s an interactive view of the reading process emerged. This view emphasizes the variable and idiosyncratic nature of the reading process. The expectation, then, is that a reader's performance will vary as a function of the interaction among many factors, including the text, the instructional setting, reader characteristics and activities, and the purpose for reading. Thus, the deficit view of reading disability has been replaced by an interactionist view that reading disability "is a relative concept, not a static state" (Lipson & Wixson, p. 115).

One intriguing outcome of research based on an interactive view of reading is the notion that observed differences in strategic processing between good and poor readers may actually be accounted for by **knowledge-based** differences. Several areas of research provide evidence to support this view.

First, studies such as those by Langer and Nicolich (1981), by Pearson, Hansen, and Gordon (1979), and by Taft and Leslie (1985) suggest the power of prior knowledge. These and related studies indicate that prior knowledge affects word recognition and comprehension for good and average readers from Grades 2 through 12. These studies have explored reading phenomena using both narrative and expository passages and a variety of recall measures.

While this line of inquiry has demonstrated that prior knowledge facilitates the comprehension of good and average readers, the effects of prior knowledge on poor readers was not initially well understood.

Studies investigating knowledge differences as potential sources of reading difficulties have demonstrated that good and poor readers with greater amounts of prior knowledge generally are able to answer more explicit comprehension questions, but poor readers, even with a well-developed knowledge base, still seem to have difficulty answering **inferential** comprehension questions (e.g., Holmes, 1983; Lipson, 1982; Marr & Gormley, 1982), i.e., questions for which answers can be inferred from text information, but the answers are not explicitly stated. Overall, the results of the good/poor reader studies support the views (a) that prior knowledge is a major influence on reading comprehension and (b) that poor readers have difficulty using prior knowledge to form inferences. As an outgrowth of these findings, researchers turned to instructional studies to investigate whether changes in instructional practices result in improved comprehension performance for poor readers. Research by Dewitz, Carr, and Patberg (1987) and by Hansen and Pearson (1983) suggests that poor readers can indeed be taught to answer inferential comprehension questions.

A second line of research emphasizing the importance of prior knowledge has been carried out by Chi and her colleagues. Chi and Koeske (1983) provide evidence suggesting that young children can perform a variety of cognitive tasks at a skill level similar to the performance of older children when the young children have strongly developed knowledge structures in a given domain. Work by Bransford et al. (1982) has demonstrated that learners who are able to make incoming information meaningful by using their own prior knowledge to elaborate text "develop knowledge structures that enable them to deal with novel situations" (Bransford, 1985, p. 392). In addition, these learners are better able to recall the information, because their processing has made the information more meaningful, thereby facilitating recall.

Thus, several studies have demonstrated the powerful effects of previously acquired knowledge on comprehension, learning, and remembering. This research provides support for the notion that what appear to be differences in strategic approaches to tasks or capacity limitations may in fact be more strongly related to a lack of well-structured knowledge within the domains relevant to a task.

Reading Dynamics of Learning Disabled Students

The findings of the cited studies are of particular interest with regard to those disabled readers classified as learning disabled (LD). While studies have demonstrated the importance of knowledge in comprehending, learning, and remembering, the impact of this research on the field of learning disabilities has been

minimal. Weisberg (1988) has proposed that researchers begin to investigate the performance of LD children using an interactive model of reading, rather than the traditional "deficit" model. Based on this perspective, the interaction of many sources of knowledge must be considered when investigating reading difficulties of LD students. Thus, it may seem useful to apply the findings of the good/poor reader studies in considering the reading difficulties of LD children.

It is not unusual to find the terms "learning disability" and "reading disability" used interchangeably in studies reported in some special education journals. However, Snider (1989) has cautioned against this tendency to generalize from the good/poor reader studies to LD children. Snider pointed out that some poor readers participating in good/poor reader studies may have had below-average IQs. Thus, given the presumption that children classified as learning disabled have at least average intelligence, it should not be assumed that LD children will inherently behave the same as the "poor" readers in good/poor reader studies.

The work of researchers and theorists within the field of LD lends weight to the need for a different perspective when considering the apparent processing deficits of LD students. Ceci and Baker (1989) and Swanson (1987) have begun to focus on explaining the task performance of LD children as an interaction of various factors, one of which is the knowledge base of the individual. The possibility that differences between learning disabled and nonlearning disabled children are related to differences in previously acquired knowledge as well as differences in processing must be considered. As Swanson asserts, "A child's knowledge base places formal restrictions on the class of logically possible strategies that can be used within a given academic domain" (pp. 156-157).

Notwithstanding an apparent connection between interactionist views of reading and interactionist views of LD dynamics, surprisingly, the importance of previously acquired knowledge to the processing of information has not been adequately explored within the field of learning disabilities. Specifically, few studies have focused on the comprehension performance of LD students based on this perspective. One noteworthy exception to this generalization is a study designed by Snider (1989) to investigate the comprehension performance of LD students while controlling for intelligence and decoding skills. Snider was particularly interested in the effects of prior knowledge and the type of reading passage (textually explicit, textually implicit, scriptally implicit). Junior-high school students selected for this study were classified as LD according to state guidelines, had IQ scores within the average range, exhibited adequate decoding skills, and lacked information and vocabulary concepts related to the topics used in the study.

Subjects in the experimental group participated in an instructional intervention in which they received 50 minutes of instruction for 13 days over a three-week period. This instruction followed a direct instruction paradigm teaching factual information and vocabulary specifically about the topics to be assessed. Subjects in the control group received the same amount of instruction, but instruction focused on literature and vocabulary content. Following instruction each subject read textually explicit, textually implicit, and scriptally implicit passages that were randomly selected and presented via computer.

Snider (1989) demonstrated that LD students directly taught the knowledge needed to answer comprehension questions of all types did significantly better than students in the control group. Snider concluded that declarative knowledge had a statistically significant impact on the comprehension questions of all types, both explicit and implicit, that LD students can answer. This work has important implications for investigating the reading comprehension performance of children classified as learning disabled. Further investigation with LD children is needed.

It seems particularly important that future studies include comparison groups of nonLD children, since comparison groups have <u>not</u> yet been employed in previous studies in this genre of LD research. It would seem especially informative to use both age peers and ability peers as comparison groups.

Basic research has demonstrated some apparent underlying deficits for children with learning disabilities. The assumption may be made that because of these deficits, the knowledge bases of children with learning disabilities may not be as well developed as those of their nonLD peers. Ceci and Baker (1989) assert that "this lack of development could set limits on how effectively they encode, retrieve, abstract, and infer in these domains" (p. 94). Thus, there is a need for research which controls for knowledge base differences between learning disabled and non-learning disabled peers. <u>It remains unclear whether research demonstrating a specific deficit for children with learning disabilities actually reflects a deficit or perhaps more likely demonstrates the child's failure to use whatever procedural skills they have within knowledge-impoverished domains.</u> At this time the question of how these students would function when they are "expert" in a given domain cannot be answered.

The issue of whether LD students can develop the "higher-order" comprehension skills needed to succeed in the content areas must be investigated. It is proposed that children with learning disabilities may be more like their nonLD peers in inferential comprehension when they have acquired necessary knowledge in specific text-related domains. If LD children's reading comprehension performance is related to lack of knowledge in various domains, rather than to processing deficits, this

finding would have important instructional implications. However, if processing deficits appear to override considerations involving previously acquired declarative knowledge, then this finding would support a more traditional view of needed interventions. In short, such research may shed further light on the nature of learning disabilities.

The purpose of the present study was to investigate the inferential comprehension performance of students classified as learning disabled. This study explored the following questions:

1. Is there a difference in the inferential reading comprehension performance of students with learning disabilities, and their normally achieving **age-level** peers and normally achieving **reading-level** peers, for passages about familiar and unfamiliar topics?

2. Do three groups of subjects (LD, LD age-peers, LD reading-level peers) perform equally well on inferential comprehension scores within **subject- and experimenter-activated** conditions and on both familiar and unfamiliar passages?

3. What is the relationship between student performance on a pretest measure of **prior knowledge** for familiar and unfamiliar topics and a posttest measure of inferential comprehension ability for the same topics?

Method

Subjects

The subjects for this study were 16 seventh and eighth graders, classified as learning disabled (ages 14-0 to 16-3), 16 normally achieving eighth graders (ages 13-5 and 16-1), and 16 normally achieving fifth graders (ages 10-5 to 11-4). The classification of a student as learning disabled was based on a multidisciplinary evaluation conducted by state certified pupil appraisal personnel in accordance with the State of Louisiana, Department of Education, Pupil Appraisal Handbook, Bulletin 1508 (1986). Normally achieving eighth graders were selected to match the average grade/age level of the LD group. Normally achieving fifth graders were selected to match the average reading level of the LD group. All fifth graders were selected from an elementary school which served as a feeder school for the seventh- and eighth-grade subjects. This selection strategy was employed to maximize the comparability of the student groups on either an age or a reading ability basis.

Subjects were selected from one local school system in the metropolitan New Orleans area. Schools selected within this system were schools that did not receive Chapter One federal funds. Chapter One schools are so designated because at least 60% of the

students receive financial assistance from Aid for Families with Dependent Children (AFDC) and at least 40% of the children qualify for the free lunch program. By selecting non-Chapter One schools it was possible to limit the confounding effects of socioeconomic status in the present study. Students enrolled in these schools were more likely to be from average or slightly above average socioeconomic backgrounds. This distinction was important because the reading passages used in the present study were previously validated with students of families with lower-middle to upper-middle class socioeconomic backgrounds (Andersson, 1981; Pitts, 1982; Pitts & Thompson, 1984).

Teachers in two middle schools and one elementary school were asked to send home letters requesting parental permission for subject participation in the study. Students identified were those regular fifth and eighth graders considered to be functioning within an average range academically and those seventh and eighth graders classified as learning disabled with a deficit in reading comprehension. Thus, the criterion for initial, tentative subject selection was teacher judgment and parent or guardian consent for participation in the study.

School records were then examined for those students who returned signed permission letters. Students were required to meet the following additional criteria to be included in the study: (a) below-average performance on a standardized reading comprehension test (CAT/CTBS 0-41st percentile) for students with learning disabilities and average to above-average performance on a reading comprehension test (CAT/CTBS 41st-84th percentile) for normally achieving eighth and fifth graders, and (b) a minimum of three (for fifth graders) or four (for seventh and eighth graders) years residence in the metropolitan New Orleans area. This latter requirement was imposed to insure some homogeneity with respect to the prior knowledge presumed in the study's reading passages. Only residents for several years would have had the opportunities to develop a well-structured knowledge base for those topics about New Orleans culture, used in some of the "familiar" passages.

In addition, during the pretest session, students were asked to read a fourth-grade passage, similar to the passages used in the study, to determine if students had adequate decoding skills. Because the passages were written at a fourth-grade level, and because only comprehension skills were investigated in the present study, it was important to be able to rule out lack of decoding skills as a possible explanation for difficulties in comprehension of the passages. Adequate decoding skills were defined as 95% word recognition accuracy (disregarding repetitions) on a fourth grade level passage read orally. All subjects in the normally achieving eighth- and fifth-grade groups met this criterion. Students proposed for the LD group who did not meet this criteria were excluded from the study. However, based on teacher report and performance on the reading comprehension subtest of the CTBS, one

LD student with 90% word recognition accuracy on the passage, was given a second fourth-grade passage to read orally. Word recognition accuracy on the second passage was 97%, so this LD student was included in the study. It was the experimenter's judgment that the subject's initial performance was due to initial discomfort with the evaluation process, rather than to decoding skill influences.

Task Materials

The materials used in the present study were taken from The Inferential Reading Comprehension Test developed by Andersson (1981). This test consists of 24 passages, each between 120 and 140 words in length, with five passage-dependent questions measuring inferential comprehension being administered for each passage. The passages are reported to have a fourth grade readability level, based on an analysis using the Dale-O'Rourke Living Word Vocabulary. The passages were developed such that they seem ambiguous unless the reader can activate specific relevant background knowledge. Six of the passages require prior knowledge of New Orleans culture, six passages require knowledge of Greek culture, six passages require knowledge of well-known events and places, and six passages require knowledge of esoteric events and places. Andersson (1981) tested these passages on school children in New Orleans and school children in New York with a Greek background. Latent-trait analyses were utilized in evaluating and revising the materials (Andersson, 1981; Pitts, 1982).

The first set of materials employed in the present study consisted of a series of questions designed to assess the subject's prior knowledge of passage topics. To assess prior declarative knowledge of topics, the five post-comprehension inferential questions were revised to develop a pre-reading measure of prior knowledge. Each student was first asked to indicate whether he/she had knowledge of the topic (e.g., Do you know what happens on Halloween night? Please circle one: "Yes," "No," "Not Sure"). The remaining four questions tested actual knowledge, as against merely self-report, and were presented to students using a multiple-choice format.

The next set of materials consisted of 16 of the 24 passages originally developed by Andersson (1981). These passages were selected because they were the eight most familiar (e.g., a Mardi Gras parade, the French Quarter, Halloween, McDonald's) and eight least familiar passages (e.g., a steel mill, a boat trip on the Rhine, maple sugar collection, Greek Independence Day) for the New Orleans sample in Andersson's study. Thus, the 16 passages were selected for use in the present study based on empirical evidence regarding passage familiarity in previous studies (Andersson, 1981; Pitts, 1982; Pitts & Thompson, 1984). Sixteen passages were used, rather than all 24, to make test administration feasible within school periods and to minimize the effects of test-induced fatigue on score reliability.

The Inferential Reading Comprehension Test was deemed especially useful for the present study because the measure allows investigation of the effects of prior knowledge on the inferential comprehension performance of LD children. By selecting passages involving topics based on the everyday knowledge of school-age children growing up in the metropolitan New Orleans area, it was possible to obtain information regarding the ability of this group of LD students to make inferences so as to comprehend text. The familiar topics all involve readily accessible cultural knowledge that students can acquire outside of school and without reading. Thus, because poor readers often have an impoverished knowledge base with regard to school-related topics, one of the difficulties in investigating the comprehension performance of LD students was avoided in the present study through the use of these passages.

Procedure

The demographic and descriptive data gathered for all subjects were: date of birth, chronological age, sex, race, grade, and number of years residence in the metropolitan area. Data on academic functioning levels on a group-administered systemwide standardized test (CTBS or CAT) were also collected.

In the pretest session each student orally read one of Andersson's (1981) passages (one not among the 16 passages used in posttesting) to the examiner in order to establish a record of word recognition accuracy and reading speed. The student's prior knowledge about the topic of each passage to be read was then measured on the knowledge pretest using the multiple-choice format.

For the test sessions each student was randomly assigned to a cell of the experimental design with the restriction of having equal numbers of students classified (k=3) as learning disabled, normally achieving eighth graders, and normally achieving fifth graders in each group. Students were randomly assigned to one of the two orders of administration (k=2) of the passages, and to one of two blocks involving different sequences (k=2) of passage presentation. Thus, the study involved three between-subject ways (3 x 2 x 2).

The students were also randomly assigned to subject- or experimenter-activation (k=2) conditions, but all subjects participated in both the prior knowledge activation conditions. Within each block half of the students participated in the subject-activation condition first, and the experimenter-activation condition second; the other half of the students participated in the experimenter-activation condition first and the subject-activation condition second. All subjects also were tested with passages involving both familiar and unfamiliar (k=2) topics. Thus, the study also involved two within-subjects ways (2 x 2) as part of a repeated measures design.

Subjects participated in two test sessions, each 30-45 minutes in length. During the first test session (8-18 days after the pretest, so as to minimize practice and memory effects involving the pretest), each student met with the examiner individually to read half of the passages and to answer comprehension questions. During the second test session (1 to 4 days later), the student again met individually with the examiner to read the remaining eight passages. However, one of the LD students became ill after the pretest session, and participated in the first test session 25 days after the pretest; the test sessions for this student were on contiguous days.

Half of the passages in each session involved topics familiar to the student and half of the passages involved topics expected to be unfamiliar to the students. In addition, passages were arranged so that each student read the easiest passage first, the hardest passage second, and so on, with passages alternating familiar/unfamiliar. Passage difficulty had already been established in previous studies (cf. Andersson, 1981), and subjects in the present study were selected to be reasonably like the subjects in previous studies with the measure. In one of the two sessions each student read eight passages and was expected to activate prior knowledge spontaneously, while in the other session the student read the other eight passages and was explicitly prompted by the examiner to activate prior knowledge.

To activate prior knowledge, the subject was asked, "Tell me what you know about ..." (e.g., steel mill). The examiner recorded and then repeated the student's response. The student was then probed two additional times, "Can you tell me anything else?" and "Do you remember anything else?" Each time the examiner recorded the student's responses and read them back to the student as a means of prompting the student to activate previously acquired knowledge related to the topic of the passage. Students in the subject-activated condition were not provided with any information or asked any questions. Thus, the prior knowledge pretest used a multiple choice format, but the remaining testing involved responses to open-ended questions.

All students were then given the following directions:

> Read this story silently. If you meet some new words, figure them out as best as you can and continue reading. When you finish reading, I want you to tell me as much as you can remember about what you have read. Then, I will ask you some questions about the story. Begin, look up when you have finished reading.

The examiner began timing the student's silent reading from the end of the directions to the point at which the student looked up. In order to inhibit the confounding effects of short term memory, a delay was introduced. The student was directed to count aloud backwards from 12 to 1.

Following this delay, the examiner requested, "Tell me what you remember about this story." This request was followed by two additional probes, "Can you tell me anything else?" and "Do you remember anything else?" The examiner audiotaped all of the student's responses.

Following the student's recall of the story, the student was given the following directions:

> Now I want you to answer some questions about the story. You may have already answered some of these questions when you were telling me about what you read, but please answer them again.

The five inferential comprehension questions were then read to the student and the examiner recorded the student's responses.

Measures

Prior Knowledge Assessment

For each of the 16 passage topics, prior knowledge was assessed by presenting the subject with one question stating the topic and asking whether or not the subject had knowledge of the topic (response: "yes," "no," "not sure") and four explicit multiple-choice questions about the topic. These four questions were explicit versions of four of the posttest comprehension questions. The examiner orally read all questions, as well as all possible multiple-choice answers, to each subject, as they themselves read the questions. The subject was directed to follow along as the examiner read and to circle the correct answer to each question on the subject's test copy. The multiple-choice answers were taken from the sets of acceptable and unacceptable responses developed by Andersson (1981).

Comprehension

Answers to the five comprehension questions following each of the 16 passages were scored as correct or incorrect on the basis of the criteria developed by Andersson (1981). In Andersson's study three judges independently identified acceptable and unacceptable responses for all inferential comprehension questions. Responses that were considered to be correct or incorrect by the judges were compiled into lists of acceptable and unacceptable answers. Using these scoring criteria the present experimenter scored all subjects' 80 (16 x 5) responses as either right or wrong.

For 13 of the 16 passages (Andersson, 1981), the first of the five inferential comprehension questions required the reader to make inferences in order to establish the general topic of the passage. For these passages questions began with one of the following: "What happening is described?"; "What day is described?"; "What is being described?"; "Where does this story take place?"; or "What holiday is described?". For the remaining three passages, Andersson's original questions were more specific and did not follow this general pattern (e.g., "What is a stone

wall for?"; "On what part of the front would you see patterned iron work?"; "What is made in these buildings?") For this reason the first question for each of these three passages (topics: boat trip on Rhine River, French Quarter, or steel mill) was changed in the present study so as to follow the same general pattern used for questions regarding the other 13 passages.

Results

Descriptive and demographic information were obtained so as to be able to describe the sample. Table 1 presents the means and standard deviations for chronological age, years in New Orleans, and percentiles and scaled scores in reading comprehension across the three student groups. All subjects, ranging in age from 10 to 16, had resided in the metropolitan New Orleans area for a minimum of three years. The LD seventh and eighth graders and the normally achieving eighth graders were similar in terms of age (M=14.38 and 13.75, respectively). The normally achieving fifth graders were younger (M=10.69), as expected. While it was not expected that the LD group would have resided in the metropolitan New Orleans area, on average, longer than the other two groups, all students had resided in the area long enough to be knowledgeable about those passage topics related to New Orleans culture (e.g., Mardi Gras, French Quarter).

INSERT TABLE 1 ABOUT HERE.

In terms of student performance on a reading comprehension subtest of a standardized achievement test, the most recent scores on the CTBS or CAT are presented in Table 1. For students in the LD group, 11 sets of scores are reported for the CTBS and five sets of scores are reported for the CAT. For the normally achieving eighth graders, all 16 sets of scores reported are for the CTBS. For the normally achieving fifth graders, all 16 sets of scores reported are for the CAT. In addition, 90% of the test scores reported are based on results from test administration in 1989, while the remaining 10% of test scores are based on test administration in either 1987 or 1988. While scores for the subtests on these two standardized achievement tests (CTBS, CAT) should reflect similar levels of student functioning, it might be noted that these two tests were normed using different, though presumably comparable, samples.

Table 2 presents means for each group on pretest variables. During the pretest, subjects read one passage orally to establish a record of decoding accuracy and speed on a fourth-grade passage similar to those used during testing. The passage used as a pretest was another passage developed by Andersson (1981), but one <u>not used in the posttest</u> in the present study. During the pretesting session subjects also completed a test with a multiple-choice format to assess the extent of prior knowledge of the 16 topics used in the posttesting for the study. Table 2 presents descriptive and

inferential statistics associated with number of words read correctly, time to read the passage, rate, and knowledge of the 16 familiar and unfamiliar topics, across the three groups of subjects.

INSERT TABLE 2 ABOUT HERE.

These descriptive data indicate that the students in the LD group and the students in the normally achieving eighth- and fifth-grade groups were **similar in terms of levels of prior knowledge** for both the eight familiar and the eight unfamiliar topics. A oneway MANOVA indicated that the three sets of two means on the prior knowledge (both familiar and unfamiliar) pretests, each of the two pretests involving four right-wrong answers on eight different passages, did not differ to a statistically degree across the three subject groups (lambda=.81, F=2.42, df=4/88, p>.05). In addition, students in each group demonstrated **statistically significant differences between pretest performance for familiar topics versus unfamiliar topics**: (a) for the 16 LD students, t=15.04 (p<.001); (b) for the 16 normally achieving eighth graders, t=21.39, (p<.001); and (c) for the 16 normally achieving fifth graders, t=17.67 (p<.001). These findings suggest that expected patterns of differential familiarity with passage content did occur, as in previous studies (Andersson, 1981; Pitts, 1982; Pitts & Thompson, 1984).

There was a statistically significant difference between the three groups for **number of words read correctly** on the pretest passage (M=135.19, 137.75, 137.88, respectively). The effect size for this comparison was noteworthy (eta^2 = 73.6/314.8 = 23.4%). But while the students with learning disabilities did read fewer words correctly than the two other groups, student performance was within the criterion established for word recognition accuracy, as explained previously. The subjects were considered reasonably homogeneous with respect to basic decoding skills.

There was a statistically significant difference between groups for **time to orally read the pretest passage**. Students in the LD group took longer to read the pretest passage when compared to the students in the other two groups (M=95.06 seconds, 58.56 seconds, 67.00 seconds, respectively). The effect size for this comparison was more noteworthy (eta^2 = 11,685.0/ 35,915.9 = 32.5%). The 16 LD students took appreciably longer to read the passage, as expected.

Several variables were also evaluated to examine subject performance on the posttest comprehension measures with respect to variables that were not the primary focus of substantive analyses. Table 3 presents group means for seconds taken to silently read the 16 posttest passages across the familiarity of topic and student group conditions. While the regularly achieving eighth and fifth graders required equivalent amounts of time to read both eight

familiar and the eight unfamiliar passages, as reported in Table 3, there were statistically significant differences (p<.001) in reading time across the three groups, due to the disparate reading rates of the LD students.

INSERT TABLE 3 ABOUT HERE.

To answer the first research question of interest in this study, a balanced 3x2x2 (student type x passage block x order) multivariate analysis of variance (MANOVA) was used to determine whether there was a difference in the inferential comprehension performance of students with learning disabilities, as compared to their normally achieving age-level and their normally achieving reading-level peers, with respect to passages about familiar and unfamiliar topics. For this series of data the students read eight passages about familiar topics and eight passages about unfamiliar topics. The five inferential comprehension questions for each of the eight familiar passages and the five inferential comprehension questions for each of the eight unfamiliar passages were scored right-wrong, and the summated scores (each ranging from 0 to 40) for these two passage types were the two dependent variables. For each set of scores the analysis examined the main effects of Student Type, Block, and Order, and the interaction of these factors.

No statistically significant interactions were observed for Student Type x Block x Order, Block x Order, or Student Type x Order. The three-way MANOVA did produce one statistically significant interaction, Student Type x Block (F(4/70)=3.75, p<.01, lambda = .68). Univariate analysis of variance isolated no statistically significant F-values for the two-way interaction, Student Type x Block. Thus, the interaction effect was truly multivariate.

The MANOVA produced statistically significant main effects for both **Student Type** (F(4/70)=5.12, p<.001, lambda = .60) and **Block** (F(2/35)=4.22, p<.05, lambda = .80). Since smaller lambda values represent larger effect sizes, the effect size for the Student Type way was more substantial than the effect size for the Block way. Univariate analysis of variance for Block isolated statistically significant F-values for both familiar (F(1/36)=4.92, p<.05) and unfamiliar (F(1/36)=8.32, p<.01) passages.

The a priori expectation was that the students in the LD group would be similar to their reading-level peers, and that both groups would differ in performance from the LD students' age peers. A MANOVA planned contrast (Thompson, 1985, 1988) of the 16 LD students as against their 16 reading-level peers was not statistically significant (F(2/35)=.13, p=.879, lambda=.99). A MANOVA planned contrast of the 16 normally achieving eighth graders as against the 32 students in the LD and normally achieving fifth-grade groups was statistically significant (F(2/35)=11.59, p<.001,

lambda=.60). The finding that the first planned contrast involved a near-zero effect size (1 -lambda = 1-.99 = .01), together with the fact that the omnibus main effect lambda for Student Type (.60) and the lambda for the second planned contrast (.60) were virtually idencical, suggests that **nearly all the difference in the three groups was characterized by (a) similarities between the LD students and their reading-level peers and (b) dissimilarities between the normally achieving eighth graders as against the LD students and the normally achieving fifth graders.** Univariate analysis of variance for Student Type isolated significant F-values for scores on both familiar ($F(2/36)=9.29$, $p<.001$) and unfamiliar ($F(2,36)=9.98$, $p<.001$) passages.

Once a significant overall MANOVA was found, the next step was to investigate specific differences between groups. Discriminant analysis was used to investigate the source of differences in the group means for the main effect, Subject Type, an effect of primary interest in the present study. Two discriminant functions were derived and their lambdas were .6658 and .9988, respectively. The first likelihood ratio was statistically significant ($chi^2 = 18.10$, $\underline{df}=4$, $\underline{p}=.0012$). The second lambda, in addition to involving a near-zero (1 - lambda) effect size, was not statistically significant ($chi^2 = .06$, $\underline{df}=1$, $\underline{p}=.8138$). Thus, only the first function warrants discussion.

Centroids, i.e., mean discriminant function scores for the groups, indicate which groups are discriminated by a given function. The centroids for the three Student Type groups were: (a) LD students, -.407; (b) normally achieving eighth graders, .964; and (c) normally achieving fifth graders, -.558. These results suggest that Function I was primarily useful in indicating how the 16 normally achieving eighth graders were different from the subjects in the remaining two groups, both of which were more similar to each other.

Discriminant function coefficients are least squares weights (analogous to regression beta weights) used to maximally discriminate the groups. The function coefficients on Function I for the scores on the familiar and the unfamiliar posttest passages were .565 and .582, respectively. However, function coefficients are influenced by correlation among the variables, so it is also useful to consult the correlation coefficients between scores on the observed variables and the discriminant functions, i.e., structure coefficients. The structure coefficients on Function I for the scores on the familiar and the unfamiliar posttest passages were .868 and .876, respectively. These results suggest that scores on <u>both</u> passage types were relatively equal in their ability to isolate the pattern of group differences and similarities that was noted.

The study's <u>second research question</u> focused on potential differential effects from allowing the subjects to spontaneously

activate text-relevant prior knowledge as against the experimenter explicitly activating this knowledge. A balanced 3x2x2x2x2 (Student Type x Block x Order x Activation x Familiarity) repeated measures multivariate analysis of variance (MANOVA) was used to determine whether the three groups of subjects performed equally well on inferential comprehension scores within subject- and experimenter-activated conditions and on both familiar and unfamiliar passages. The inferential comprehension scores for the 16 posttest passages administered first, second, and so forth, within block and order conditions, were the dependent variables. Thus, for this analysis there were 16 dependent variables.

Because all students were assigned across various block and order conditions, the first passage read in the subject-activated condition was not the same for all subjects. For example, depending on Block and Order assignment, the first passage to be read was either about Halloween or Christmas. Thus, scores for each dependent variable involved the sum of correct comprehension questions for either of the two possible passages administered first in this example. It should be noted that a pattern alternating the easiest passage with the hardest was followed so that the first passage to be read was always one of the two easiest familiar passages, the next passage to be read was always one of the two hardest unfamiliar passages, and so on, working from the extremes of easiest familiar and hardest unfamiliar to the middle (i.e., the hardest familiar topic and the easiest unfamiliar topic). Students always received an easy familiar passage first and then passages alternated familiar/unfamiliar for each session. This pattern was followed to mitigate the confounding that would have occurred if the passages had been sequenced by difficulty, and difficulty had interacted with fatigue effects.

The results of the MANOVA are presented in Table 4. For each of the scores (ranging 0 right answers to 5 right answers) on the 16 dependent variables (passages), this analysis examined the main effects of Student Type, Block, and Order and the interaction of these as between-subject factors. The analysis also examined the main effects and interactions involving two within-subjects factors, Schema Activation and Topic Familiarity.

INSERT TABLE 4 ABOUT HERE.

No statistically significant interactions for Student Type x Block x Order, Block x Order, Student Type x Order, or Student Type x Block were produced. For tests involving Activation as a within-subjects factor and the interaction of Activation with the three between-subjects factors noted above, only one statistically significant interaction, **Student Type x Activation**, was produced ($F(8/66)=2.39$, $p=.025$, lambda = .60).

For tests involving Topic Familiarity as a within-subjects

factor and the interaction of Familiarity with the three between-subjects factors--Student Type, Block, Order--one statistically significant interaction, **Student Type x Block x Familiarity**, was isolated ($F(8/66)=2.15$, $p=.043$, lambda = .63). No other statistically significant interactions involving Familiarity and the between-subjects factors were observed.

For tests involving both Activation and Topic Familiarity as within-subjects factors and the interaction of the Activation x Familiarity effect with the three between-subjects factors, two statistically significant interactions, **Student Type x Activation x Familiarity** ($F(8/66)=2.26$, $p=.034$, lambda = .62) and **Activation x Familiarity** ($F(4/33)=16.58$, $p<.001$, lambda = .33), were produced. No statistically significant interactions were observed for Student Type x Block x Order x Activation x Familiarity, Block x Order x Activation x Familiarity, Student Type x Order x Activation x Familiarity, Student Type x Block x Activation x Familiarity, Order x Activation x Familiarity, or Block x Activation x Familiarity.

When the main effects were considered for the between-subjects factors in the repeated measures analysis, only one statistically significant main effect emerged, the Student Type main effect ($F(8/66)=2.86$, $p=.009$, lambda = .55). A repeated measures MANOVA planned contrast of the 16 LD students as against their 16 reading-level peers was not statistically significant ($F(4/33)=.23$, $p=.918$, lambda=.97). A MANOVA planned contrast of the 16 normally achieving eighth graders as against the 32 students in the LD and the normally achieving fifth-grade groups was statistically significant ($F(4/33)=6.35$, $p<.001$, lambda=.56). The finding that the first planned contrast involved a near-zero effect size (1 - lambda = 1-.97 = .03), together with the fact that the omnibus main effect lambda for Student Type (.55) and the lambda for the second planned contrast (.56) were virtually identical, <u>again</u> suggests that **nearly all the difference in the three groups was characterized by (a) similarities between the LD students and their reading-level peers and (b) dissimilarities between the normally achieving eighth graders as against the LD students and the normally achieving fifth graders.**

A statistically significant main effect for the within-subjects **Activation** factor was produced ($F(4/33)=3.01$, $p=.032$, lambda = .73). For tests involving Topic Familiarity as a within-subject factor as a main effect or in interaction with the three between-subjects factors, a statistically significant main effect for the within-subjects **Familiarity** main effect was produced ($F(4/33)=868.69$, $p<.001$, lambda = .01). The effect size (1 - lambda = 1 -.01 = .99) was nearly perfect.

The study's <u>third research question</u> involved relationships between scores on the prior knowledge pretesting and scores on the open-ended inferential comprehension posttest questions. As noted previously, for each of the 16 topics (eight familiar and eight

unfamiliar) the students were asked if they had any knowledge of the topic and then students also responded to four multiple-choice questions about each topic. Thus, each student completed a 64-item (4 x 16 = 64) multiple-choice pretest for which responses were scored right-wrong.

With regard to student self-reported knowledge of the 16 topics, Table 5 presents the percentage of students indicating that they had knowledge of the topic ("yes") and the percentage of students indicating no knowledge of the topic ("no" and "not sure" responses). In general, most students indicated that they had knowledge for topics expected to be familiar, and had inadequately developed knowledge for topics expected to be unfamiliar. However, it is interesting to note that the normally achieving eighth graders, and to a lesser extent the fifth graders, demonstrated a more clearcut pattern for knowledge of topics, while the pattern of responses for the LD group seemed more ambiguous. The normally achieving eighth graders were more homogeneous in reporting either that they knew about a topic or conversely that they did not have knowledge of a topic. Such results might be expected, since LD students apparently are meta-cognitively less aware of what they know and what they do not know.

INSERT TABLE 5 ABOUT HERE.

Two-way factorial ANOVAs were conducted for each of the 16 passages to explore the relationships between the subjects' responses to the self-report prior knowledge questions (scored here "yes" or "no/not sure", i.e., $\underline{k}=2$) and student type ($\underline{k}=3$) with the actual performance on the five posttest inferential comprehension questions for the 16 passages. Table 6 presents the results of 16 separate two-way ANOVAs. A statistically significant main effect for student type was produced for four passages, while no statistically significant effects were produced for the student self-reported knowledge main effect or for the interaction of student type and student self-reported knowledge. The analysis could not be completed for one passage, Mardi Gras, a Familiar passage, because 100% of the students said that they had prior knowledge of the topic.

INSERT TABLE 6 ABOUT HERE.

Discussion

The purpose of the present study was to investigate the inferential reading comprehension performance of students with learning disabilities. Based on an interactive view of reading comprehension, the position was taken that comprehension involves the interaction of various sources of the reader's knowledge. In addition, based on this view, comprehension of text involves the reader as an active participant who must interrelate knowledge and

textual information so as to create meaning. While at this time it is not possible to delineate all of the internal and external factors that influence the reading process, in the present study attention was focused primarily on the reader's knowledge base. One factor external to the reader is also important in understanding the results of the present study. The 16 test passages were written so that the text was ambiguous and difficult to understand unless the reader activated prior knowledge.

Thus, one way in which the present study differed from previous work was that each of the 16 passages used in the study (Andersson, 1981; Pitts, 1982; Pitts & Thompson, 1984) require the reader <u>to make inferences</u> to comprehend passage meaning. Previous research has demonstrated that comprehension of textually explicit information is easier than comprehension requiring the reader to integrate textual information with prior knowledge (e.g., Holmes, 1983; Lipson, 1982; Snider, 1989). Studies have been cited which support the notion that this integration is facilitated by well-developed prior knowledge schemata (e.g., Langer & Nicolich, 1981; Pearson, Hansen, & Gordon, 1979; Taft & Leslie, 1985).

As noted, the information presented in the test passages should have seemed arbitrary to the reader and difficult to understand and remember unless the reader possessed and was able to activate adequately-developed topic-relevant schemata. In addition to previously acquired knowledge of the topic, the reader must also have knowledge about how to derive meaning from implicit text (i.e., procedural knowledge). Thus, consistent with the findings of previous studies, it was expected in the present study that subjects would be able to answer more inferential comprehension questions about familiar topics and fewer inferential comprehension questions on passages about unfamiliar topics. The results presented in Tables 2 and 4 support the view that expected differences in topics familiarity did arise. As expected based on previous research, the students were able to answer more inferential comprehension questions about familiar topics and fewer inferential comprehension questions about unfamiliar topics. These results emphasize again the powerful effect of prior knowledge on a reader's comprehension.

The present study contributes to the literature by comparing the comprehension performance of students with learning disabilities to the performance of their normally achieving age-level peers, and by comparing the performance of the students with learning disabilities to the performance of their normally achieving reading-level peers. Based on a review of the literature it is unclear whether or not learning disabled children can answer inferential comprehension questions, even when they have an adequately developed knowledge base for a topic, and especially when they lack such a knowledge base.

Thus, the first research question was designed to investigate

subject group differences in performance on tasks requiring inferential comprehension. The findings reported in Table 4 suggest that children with learning disabilities can answer inferential questions when they have an adequately developed knowledge base, although not as proficiently as their normally achieving age-level peers. Thus, there was no evidence of a breakdown in the skill processing mechanisms used by LD students. As indicated by the planned contrasts tests, the performance of the students with learning disabilities is comparable to the performance of their normally achieving reading-level peers, as against the performance of their normally achieving age-level peers.

Snider (1989) has proposed that LD children's performance on cognitive tasks, in this case reading comprehension, can be explained in terms of inadequately elaborated representation of knowledge in relevant domains. Snider directly taught LD adolescents factual information and vocabulary specifically about the topics to be assessed. She reported that following instruction students in the experimental group answered comprehension questions with greater accuracy when compared to the performance of the control group. In addition, Snider found the same pattern of results reported in the good/poor reader literature. For the LD students in her study, textually explicit questions were reported to be the easiest, and scriptally implicit questions were the most difficult for all students. It should be emphasized that Snider did not teach students strategies or techniques that would facilitate making inferences while reading; she only taught required background knowledge to instantiate text-relevant schemata.

The position is taken here that students must have an adequately developed knowledge base that includes both procedural and declarative prior knowledge. Thus, it seems possible that while the subjects in the LD and the normally achieving fifth-grade groups had adequately developed declarative prior knowledge of the familiar topics, they may have lacked procedural knowledge for how one goes about making the inferences needed to comprehend text. For the fifth graders, this procedural knowledge is likely to involve gradually acquired skills requiring both instruction and practice. For students in the learning disabled group it seems possible that, although they have been in school longer than the fifth graders, they have had neither the instruction nor the practice needed to develop the necessary procedural knowledge for this task.

Thus, the differences observed in the comprehension performance of students in the three groups may be related to the adequacy of the knowledge base. Subjects in the LD and normally achieving fifth-grade groups may have less elaborated knowledge structures as compared to the knowledge representation for the normally achieving eighth graders. As noted previously, a well-developed knowledge base must include both declarative and

procedural knowledge. In this study it appears that the LD students may have inadequately developed procedural knowledge for what to do when they are required to make inferences, particularly with regard to less familiar topics.

Another way in which this study contributes to the literature is related to the investigation of student performance on passages about familiar and unfamiliar topics under two treatment conditions: (a) a condition in which the subject is expected to activate prior knowledge spontaneously and (b) a condition in which the subject is prompted by the experimenter to activate prior knowledge. It seems important to investigate sources of schema activation so as to understand the results of earlier studies investigating the effects of prior knowledge on comprehension. In some studies (e.g., Langer & Nicolich, 1981; Marr & Gormley, 1982) researchers assessed prior knowledge immediately before students read passages and answered comprehension questions. In other studies (e.g., Holmes, 1983; Lipson, 1982) researchers added a one to two week delay between prior knowledge assessment and test sessions. This is an important distinction to make because the impact of the prior knowledge assessment on the activation of relevant schemata for the reader must be considered. Thus, it was expected that differential performance would be observed for conditions in which subjects must rely on their own activation of relevant schemata in contrast to conditions in which an experimenter prompts the subject to activate schemata.

The subjects in all three groups responded favorably to experimenter prompting. This finding has important implications for how students with learning disabilities, and all students, learn. However, it is particularly interesting to note that when performance on familiar passages within the subject-activated condition was compared to performance on familiar topics within the experimenter-activated condition, a statistically significant difference in scores was noted only for the normally achieving fifth graders ($t=-3.34$, $p<.01$). The standard deviation (2.39) for this group suggests the wide variability of performance on familiar topics for these students relative to the variation in performance for the other two groups. No statistically significant differences were found for performance within these conditions for the students in the LD or normally achieving eighth-grade groups. Thus, for familiar topics the LD students and their normally achieving age-level peers apparently did not need experimenter-prompting to activate their prior knowledge. However, when performance on unfamiliar passages in the two conditions is compared, it is important to note that all three student groups significantly benefitted from experimenter-activation (LD group: $t=-4.64$, $p<.000$; normally achieving eighth-grade group: $t=-3.62$, $p<.01$; normally achieving fifth-grade group: $t=-2.57$, $p<.05$). It should be emphasized that these were difficult passages to comprehend, not in terms of word recognition, but in terms of the manipulation involved in extrapolating inferences from passages about less

familiar topics.

When students do not have an adequately developed knowledge representation for information to be learned, the new information may seem arbitrary and difficult to understand and remember. Therefore, the student may need instructional support to facilitate learning, understanding, and remembering. Fully elaborated texts may provide the necessary support to enable students to utilize prior knowledge to integrate new information. But learning the procedural knowledge necessary to extrapolate meaning from passages demanding more inference is a different business.

On inferential tasks it may be necessary for the teacher to provide students with experiences and information which help them to clarify facts and relationships in terms of their significance or relevance (Bransford, 1985). In this study, in one condition the experimenter explicitly prompted the students in order "to help the child activate various preexisting 'pockets' of knowledge that previously had been unrelated, and to help the child reassemble these 'pockets' of knowledge into an integrated schema" (Bransford, 1985, p. 390).

It seems evident that whenever students are presented with information for which they do not have a well-developed knowledge base, students will need various types of instructional support to help them integrate the new information with prior knowledge, so that learning can occur. In addition to teacher and instructional material support, a cognitive approach to learning also supports the notion of teaching students "how to learn" (Weinstein & Mayer, 1985). Thus, not only is it important for teachers to structure learning situations in such a way that students are helped to activate prior knowledge, it is also important that students are taught "how to learn." With regard to inferential comprehension performance, specific strategies and techniques (e.g., Dewitz, Carr, & Patberg, 1987; Hansen & Pearson, 1983; Langer, 1984) can be made available to the learner which will facilitate the reader's inferential comprehension performance.

Finally, the present study makes a contribution to the literature by utilizing a multivariate perspective. Analyses grounded in this perspective control "experimentwise" inflation of Type I error rates, and more importantly, "honor" the complexity of a reality in which most phenomena are multiply caused and most causes have multiple effects (Fish, 1988; Thompson, 1986). Phenomena involving inferential reading comprehension and the nature of learning disabilities inherently have exactly this sort of complexity. Previous studies in this literature have very rarely employed such analyses. A comparison of the Table 6 results with the MANOVA outcomes illustrates these benefits.

Several unique features of this study have been discussed. With regard to recommendations for future research, first,

additional studies investigating the effects of prior knowledge on the inferential comprehension performance of students with learning disabilities, and their age-level and reading-level peers are needed. It will be important to replicate the support in the present study for the role of well elaborated knowledge structures in comprehension. The notion that the adequacy of the knowledge base may actually set limits on the processing of information for students with learning disabilities merits further investigation. Only as researchers elaborate the nature of LD cognitive dynamics will we be enabled to develop more effective instructional interventions for these students. One research tack falling within this genre of inquiry would involve replicating the present design with different groups of students and with different sets of familiar and unfamiliar passages.

Further research is also needed to investigate the effects of schema activation conditions. In the present study it was found that all three groups of readers benefited from receiving experimenter activation of schema. But it is not yet clear that students benefit from prompting by the teacher for all sorts of tasks. And optimal activation protocols that are effective in the short run, and that also facilitate self-activation and independence over the long run, remain to be articulated. It will be especially important to investigate these issues with respect to LD students.

Finally, research is needed that focuses on the development of reliable and efficient prior knowledge assessment measures. Several factors, including the types of students, types and number of topics to be assessed, response mode, and objectivity in scoring responses, must be considered. And continued exploration of the effects of prior knowledge would benefit dramatically from improvement in the methodology used in previous studies.

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Table 1
Means and Standard Deviations for Chronological Age, Years in New Orleans, and Percentiles and Scaled Scores in Reading Comprehension

Variable	Learning Disabled M	SD	Normally Achieving Eighth Graders M	SD	Normally Achieving Fifth Graders M	SD
Chronological Age (in years)	14.38	.72	13.75	.93	10.69	.48
Years in Metro New Orleans	13.19	2.79	9.88	4.50	10.06	1.61
Comprehension Percentile	24.00	9.93	63.88	13.08	67.38	16.24
Comprehension Scaled Score	693.56	42.92	767.31	16.50	721.00	21.28

Table 2

Means and Standard Deviations for Pretest Variables by Group

Variable	Learning Disabled M	SD	Normally Achieving Eighth Graders M	SD	Normally Achieving Fifth Graders M	SD	F
Words Correct	135.19	3.31	137.75	1.44	137.88	1.75	6.8684*
Time	95.06	32.64	58.56	19.13	67.00	13.57	10.8503**
Rate	97.64	33.42	152.09	34.03	129.33	26.39	
Prior Knowledge Familiar	29.38	1.50	30.12	1.15	30.06	1.34	1.5501
Unfamiliar	18.75	3.44	20.00	1.86	17.69	3.07	2.6042
Total	48.12	4.48	50.12	2.45	47.75	3.82	1.9226

* $p < .01$

** $p < .001$

Table 3

Comparison of Means and Standard Deviations for Time (in Seconds) to Read Passages by Group

Variable		Learning Disabled M	Learning Disabled SD	Normally Achieving Eighth Graders M	Normally Achieving Eighth Graders SD	Normally Achieving Fifth Graders M	Normally Achieving Fifth Graders SD	F
Familiar:								
Passages	1	74.69	35.17	46.31	11.00	47.31	12.92	
	2	70.62	24.80	43.06	11.08	46.50	10.13	
	3	70.31	24.18	45.56	13.64	46.19	11.00	
	4	68.75	27.95	49.44	12.10	44.62	10.90	
	5	80.88	28.81	51.56	15.34	48.69	10.85	
	6	83.38	41.40	48.75	16.51	49.56	13.30	
	7	83.88	38.33	52.81	13.16	51.52	13.48	
	8	83.75	44.10	54.94	17.38	59.88	13.16	
Subtotal		648.00	251.35	426.69	95.13	426.00	79.04	10.02**
Unfamiliar:								
Passages	9	83.88	36.51	54.25	12.79	50.50	15.40	
	10	92.88	52.35	53.00	16.32	58.12	26.74	
	11	77.06	31.82	49.44	15.31	48.94	10.70	
	12	90.69	43.45	54.62	10.64	52.12	13.86	
	13	88.75	41.11	57.81	13.91	56.56	14.89	
	14	83.38	38.01	50.25	11.47	51.69	15.62	
	15	83.50	33.19	51.31	16.41	54.94	12.90	
	16	81.25	40.98	51.69	11.53	49.06	11.62	
Subtotal		693.3	305.01	439.75	89.33	434.25	100.51	9.47**

** $p < .001$

Note. Passage topics are listed in Table 5.

Table 4

Results of Multivariate Test of Significance of Inferential Comprehension Scores

Between-Subjects Effects			
Source	lambda	Exact F	Sig. of F
Student Type x Block x Order	.84538	.72278	.671
Block x Order	.97023	.25318	.906
Student Type x Order	.84966	.70016	.690
Student Type x Block	.90983	.39918	.917
Order	.86507	1.28679	.295
Block	.80140	2.04446	.111
Student Type	.55183	2.85587	.009**
Within-Subject Effect-Activation			
Student Type x Block x Order x Activation	.77183	1.14331	.347
Block x Order x Activation	.77478	2.39819	.070
Student Type x Order x Activation	.76172	1.20268	.311
Student Type x Block x Activation	.89267	.48189	.865
Order x Activation	.92825	.63769	.639
Block x Activation	.80698	1.97325	.122
Student Type x Activation	.60147	2.38771	.025*
Activation	.73236	3.01488	.032*
Within-Subject Effect-Familiarity			
Student Type x Block x Order x Familiarity	.86400	.62561	.753

Block x Order x Familiarity	.76658	2.51210	.060
Student Type x Order x Familiarity	.79880	.98071	.459
Student Type x Block x Familiarity	.62881	2.15385	.043*
Order x Familiarity	.76223	2.57351	.056
Block x Familiarity	.86201	1.32061	.283
Student Type x Familiarity	.22414	1.99835	.060
Familiarity	.00941	868.68997	.000***
<u>Within-Subjects Effect-Activation x Familiarity</u>			
Student Type x Block x Order x Activation x Familiarity	.85074	.69448	.695
Block x Order x Activation x Familiarity	.91199	.79615	.536
Student Type x Order x Activation x Familiarity	.88354	.52691	.832
Student Type x Block x Activation x Familiarity	.73863	1.34929	.235
Order x Activation x Familiarity	.90627	.85328	.502
Block x Activation x Familiarity	.92880	.63241	.643
Student Type x Activation x Familiarity	.61617	2.26003	.034*
Activation x Familiarity	.33226	16.58026	.000***

* $p < .05$
** $p < .01$
*** $p < .001$

Table 5

Percentages by Group for Responses to a Prior Knowledge Question "Do you know what/how [topic]?"

	Learning Disabled	Normally Achieving Eighth Graders	Normally Achieving Fifth Graders
Familiar Topics			
Halloween - Yes	93.8%	100.0%	100.0%
No/Not Sure	6.3%		
Christmas - Yes	93.8%	100.0%	100.0%
No/Not Sure	6.3%		
Baseball - Yes	93.8%	100.0%	93.8%
No/Not Sure	6.3%		6.3%
Mardi Gras - Yes	100.0%	100.0%	100.0%
No/Not Sure			
Beach - Yes	93.8%	100.0%	100.0%
No/Not Sure	6.3%		
Amusement Park - Yes	87.5%	93.8%	100.0%
No/Not Sure	12.5%	6.3%	
McDonald's - Yes	93.8%	100.0%	100.0%
No/Not Sure	6.3%		
French Quarter - Yes	87.5%	87.5%	87.5%
No/Not Sure	12.5%	12.5%	12.5%
Unfamiliar Topics			
Maple Sugar - Yes	25.0%		18.8%
No/Not Sure	75.0%	100.0%	81.3%
Orthodox Baptism - Yes	12.5%		18.8%
No/Not Sure	87.6%	100.0%	81.3%
Forty-Day Memorial - Yes	18.8%	12.5%	50.0%
No/Not Sure	81.3%	87.5%	50.0%
Steel Mill - Yes	37.5%	6.3%	6.3%
No/Not Sure	62.5%	93.8%	93.8%
Boat Trip Rhine River - Yes	12.5%	6.3%	37.5%
No/Not Sure	87.6%	93.8%	62.6%
Greek Independence Day - Yes	6.3%		6.3%
No/Not Sure	93.8%	100.0%	93.8%
Orthodox Easter - Yes	18.8%		12.5%
No/Not Sure	81.3%	100.0%	87.5%
Nameday - Yes	6.3%		
No/Not Sure	93.8%	100.0%	100.0%

Table 6

Analysis of Variance of Passage Posttest Comprehension Scores

Passage	Prior Knowledge Yes No (PK)	Student Type (ST)	PK X ST	Within
Familiar Topics				
Halloween				
MS	.04	.16		.08
F	.49	2.12		
Christmas				
MS	.15	1.00		.30
F	.50	3.37*		
Baseball				
MS	.17	.18	.002	.23
F	.72	.75	.009	
Mardi Gras				
MS				
F				
Beach				
MS	.20	.74		.32
F	.64	2.34		
Amusement Park				
MS	.64	1.88	.26	.73
F	.88	2.59	.35	
McDonald's				
MS	1.20	4.39		.94
F	1.29	4.70*		
French Quarter				
MS	.24	2.27	.92	1.34
F	.18	1.69	.68	
Unfamiliar Topics				
Maple Sugar				
MS	.01	5.88	.30	2.19
F	.005	2.68	.14	
Orthodox Baptism				
MS	.96	12.21	.34	1.62
F	.59	7.51**	.21	
Forty Day Memorial				
MS	.34	.60	.00	.84
F	.40	.71	.00	
Steel Mill				
MS	.07	.41	1.22	1.62
F	.04	.25	.75	
Boat Trip Rhine River				
MS	1.77	1.77	.70	.69
F	2.56	2.57	1.01	
Greek Independence Day				
MS	.03	4.08	.08	1.62
F	.02	2.52	.05	
Orthodox Easter				
MS	1.02	1.88	.01	.56
F	1.79	3.32*	.02	
Name Day				
MS	1.67	.25		.90
F	1.85	.28		

* $p < .05$ **$p < .01$

Note. "MS" = "Mean Square"; "F" = the calculated *F* statistic. For these analyses, df = 1 for prior knowledge; df = 2 for student type and PK X St two-way interaction; df = 42 for within. Everyone self-reported knowledge of Mardi Gras, so the two-way ANOVA could not be computed for that passage. Some interactions could not be computed due to cell sizes being zero for some variable combinations.

APPENDICES

Additional Tables of Results

Table A.1
Results of Multivariate Test of Significance of Inferential Comprehension Scores on Familiar and Unfamiliar Passages

Source	lambda	Exact F	Significance of F
Student Type x Block x Order	.93271	.62030	.650
Block x Order	.87761	2.44062	.102
Student Type x Order	.93961	.55360	.697
Student Type x Block	.67806	3.75219	.008**
Order	.94483	1.02194	.370
Block	.80584	4.21651	.023*
Student Type	.59831	5.12433	.001*

* p < .05

**p < .01

Table A.2

Summary of Cell Means: Student Type X Block

	Student Type					
	Learning Disabled		Normally Achieving Eighth Graders		Normally Achieving Fifth Graders	
Measure	Blk 1	Blk 2	Blk 1	Blk 2	Blk 1	Blk 2
Familiar	37.25 (2.49)	34.12 (3.18)	39.00 (1.51)	38.25 (1.16)	35.62 (2.20)	34.88 (3.14)
Unfamiliar	13.50 (5.10)	13.00 (4.75)	19.50 (3.16)	16.88 (3.09)	16.00 (2.45)	9.75 (2.05)

Note. Standard deviations are presented in parentheses.

Table A.3

Summary of Cell Means: Block Main Effect

Measure	Block 1	Block 2
Familiar	37.29	35.75
	(2.46)	(3.14)
Unfamiliar	16.33	13.21
	(4.37)	(4.66)

Note. Standard deviations are presented in parentheses.

Table A.4

Summary of Cell Means: Student Type Main Effect

	Student Type		
	Learning Disabled	Normally Achieving Eighth Graders	Normally Achieving Fifth Graders
Familiar	35.69	38.62	35.25
	(3.20)	(1.36)	(2.64)
Unfamiliar	13.25	18.19	12.88
	(4.77)	(3.31)	(3.90)

Note. Standard deviations are presented in parentheses.

Table A.5
Summary of Cell Means: Student Type Main Effect

	Student Type		
	Learning Disabled	Normally Achieving Eighth Graders	Normally Achieving Fifth Graders
DV01	4.62 (.50)	4.88 (.34)	4.44 (.73)
DV02	0.69 (.87)	1.25 (1.00)	0.81 (.83)
DV03	4.88 (.34)	4.94 (.25)	4.63 (.62)
DV04	0.81 (.66)	1.56 (1.09)	0.81 (.83)
DV05	4.44 (1.03)	4.94 (.25)	4.44 (1.09)
DV06	1.44 (1.36)	1.81 (.66)	1.69 (.70)
DV07	3.62 (1.36)	4.62 (.72)	3.12 (1.36)
DV08	1.81 (1.51)	3.19 (1.52)	2.19 (1.56)
DV09	4.81 (.40)	5.00 (.00)	4.88 (.34)
DV10	1.62 (.88)	1.69 (1.01)	1.38 (1.15)
DV11	4.69 (.48)	4.94 (.25)	4.69 (.60)
DV12	2.06 (1.18)	2.62 (1.59)	1.75 (.77)
DV13	4.38 (1.26)	4.81 (1.20)	4.75 (1.34)
DV15	4.25 (.86)	4.50 (.82)	4.31 (.48)
DV16	2.19 (1.28)	3.75 (.93)	2.31 (1.25)

Note. Standard deviations are presented within parentheses.

Table A.6

Summary of Cell Means: Student Type X Activation

	Learning Disabled		Normally Achieving Eighth Graders		Normally Achieving Fifth Graders	
	SA	ExA	SA	ExA	SA	ExA
DV01	4.62	4.81	4.88	5.00	4.44	4.88
	(.50)	(.40)	(.34)	(.00)	(.73)	(.34)
DV02	0.69	1.62	1.25	1.69	0.81	1.38
	(.87)	(.88)	(1.00)	(1.01)	(.83)	(1.15)
DV03	4.88	4.69	4.94	4.94	4.63	4.69
	(.34)	(.48)	(.25)	(.25)	(.62)	(.60)
DV04	0.81	2.06	1.56	2.62	0.81	1.75
	(.66)	(1.18)	(1.09)	(1.59)	(.83)	(.77)
DV05	4.44	4.38	4.94	4.81	4.44	4.75
	(1.03)	(.72)	(.25)	(.40)	(1.09)	(.45)
DV06	1.44	2.62	1.81	2.31	1.69	1.94
	(1.36)	(1.26)	(.66)	(1.20)	(.70)	(1.34)
DV07	3.62	4.25	4.62	4.50	3.12	4.31
	(1.36)	(.86)	(.72)	(.82)	(1.36)	(.48)
DV08	1.81	2.19	3.19	3.75	2.19	2.31
	(1.51)	(1.28)	(1.52)	(.93)	(1.56)	(1.25)

Note. SA = Student Activation
ExA = Experimenter Activation

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Table A.7

<u>Summary of Cell Means: Activation Main Effect</u>

	Treatment	
	Subject Activation	Experimenter Activation
DV01	4.64 (.56)	4.90 (.31)
DV02	.92 (.92)	1.56 (1.01)
DV03	4.81 (.44)	4.77 (.47)
DV04	1.06 (.93)	2.14 (1.25)
DV05	4.60 (.89)	4.64 (.56)
DV06	1.64 (.96)	2.29 (1.27)
DV07	3.79 (1.32)	4.35 (.73)
DV08	2.40 (1.61)	2.75 (1.34)

Note. Standard deviations are presented in parentheses.

Table A.8
Summary of Cell Means: Student Type X Block X Familiarity

	Student Type					
	Learning Disabled		Normally Achieving Eighth Graders		Normally Achieving Fifth Graders	
Measure	Blk 1	Blk 2	Blk 1	Blk 2	Blk 1	Blk 2
Familiar Passages						
DV01	4.75 (.46)	4.50 (.53)	5.00 (.00)	4.75 (.46)	4.75 (.46)	4.12 (.83)
DV03	5.00 (.00)	4.75 (.46)	5.00 (.00)	4.88 (.35)	4.62 (.74)	4.62 (.52)
DV05	4.50 (1.07)	4.38 (1.06)	4.88 (.35)	5.00 (.00)	4.25 (1.39)	4.62 (.74)
DV07	4.00 (1.41)	3.25 (1.28)	4.62 (.74)	4.62 (.74)	3.12 (1.64)	3.12 (1.13)
DV09	4.88 (.35)	4.75 (.46)	5.00 (.00)	5.00 (.00)	4.88 (.35)	4.88 (.35)
DV11	4.75 (.46)	4.62 (.52)	4.88 (.35)	5.00 (.00)	4.88 (.35)	4.50 (.76)
DV13	4.88 (.35)	3.88 (.64)	4.88 (.35)	4.75 (.46)	4.88 (.35)	4.62 (.52)
DV15	4.50 (.76)	4.00 (.92)	4.75 (.46)	4.25 (1.04)	4.25 (.46)	4.38 (.52)
Unfamiliar Passages						
DV02	.88 (.99)	.50 (.76)	1.50 (1.07)	1.00 (.92)	1.00 (.92)	.62 (.74)
DV04	.75 (.71)	.88 (.64)	1.38 (1.30)	1.75 (.89)	1.12 (.83)	.50 (.76)
DV06	1.50 (1.51)	1.38 (1.30)	1.62 (.52)	2.00 (.76)	1.75 (.89)	1.62 (.52)
DV08	2.12 (1.96)	1.50 (.92)	3.62 (1.19)	2.75 (1.75)	3.25 (1.28)	1.12 (.99)
DV10	1.12 (.83)	2.12 (.64)	1.88 (.64)	1.50 (1.31)	1.75 (1.04)	1.00 (1.20)
DV12	2.25 (1.39)	1.88 (.99)	2.88 (1.81)	2.38 (1.41)	1.75 (.89)	1.75 (.71)
DV14	2.62 (1.41)	2.62 (1.19)	2.88 (.83)	1.75 (1.28)	2.50 (1.51)	1.38 (.92)
DV16	2.25 (1.49)	2.12 (1.13)	3.75 (.89)	3.75 (1.04)	2.88 (.83)	1.75 (1.39)

Note. Standard deviations are presented within parentheses.

Table A.9

Summary of Cell Means: Familiarity Main Effect

Measure	Passage Topic Familiar		Unfamiliar
DV01	4.64 (.56)	DV02	.92 (.92)
DV03	4.81 (.44)	DV04	1.06 (.93)
DV05	4.60 (.89)	DV06	1.64 (.96)
DV07	3.79 (1.32)	DV08	2.40 (1.61)
DV09	4.90 (.31)	DV10	1.56 (1.01)
DV11	4.77 (.47)	DV12	2.14 (1.25)
DV13	4.64 (.56)	DV14	2.29 (1.27)
DV15	4.35 (.73)	DV16	2.75 (1.34)

Note. Standard deviations are presented in parentheses.

Table A.10

Summary of Cell Means: Student Type X Activation X Familiarity

	Learning Disabled		Normally Achieving Eighth Graders		Normally Achieving Fifth Graders	
	SA	ExA	SA	ExA	SA	ExA
Familiar Passages						
DV01	4.62 (.50)		4.88 (.34)		4.44 (.73)	
DV03	4.88 (.34)		4.92 (.25)		4.63 (.62)	
DV05	4.44 (1.03)		4.94 (.25)		4.44 (1.09)	
DV07	3.62 (1.36)		4.62 (.72)		3.12 (1.36)	
DV09		4.81 (.40)		5.00 (.00)		4.88 (.34)
DV11		4.69 (.48)		4.94 (.25)		4.69 (.60)
DV13		4.38 (.72)		4.81 (.40)		4.75 (.45)
DV15		4.25 (.86)		4.50 (.82)		4.31 (.48)
Unfamiliar Passages						
DV02	0.69 (.87)		1.25 (1.00)		0.81 (.83)	
DV04	0.81 (.66)		1.56 (1.09)		0.81 (.83)	
DV06	1.44 (1.36)		1.81 (.66)		1.69 (.70)	
DV08	1.81 (1.51)		3.19 (1.52)		2.19 (1.56)	
DV10		1.62 (.88)		1.69 (1.01)		1.38 (1.15)
DV12		2.06 (1.18)		2.62 (1.59)		1.75 (.77)
DV14		2.62 (1.26)		2.31 (1.20)		1.94 (1.20)
DV16		2.19 (1.28)		3.75 (.93)		2.31 (1.25)

Note. SA = Subject Activation
ExA = Experimenter Activation

Table A.11

Summary of Cell Means: Activation X Familiarity

	Treatment	
Measure	Subject Activation	Experimenter Activation
Familiar Passages		
DV01	4.64 (.56)	
DV03	4.81 (.44)	
DV05	4.60 (.89)	
DV07	3.79 (1.32)	
DV09		4.90 (.31)
DV11		4.77 (.47)
DV13		4.64 (.56)
DV15		4.35 (.73)
Unfamiliar Passages		
DV02	0.92 (.92)	
DV04	1.06 (.93)	
DV06	1.64 (.96)	
DV08	2.40 (1.61)	
DV10		1.56 (1.01)
DV12		2.14 (1.25)
DV14		2.29 (1.27)
DV16		2.75 (1.34)

Note. Standard deviations are presented in parentheses.

Table A.12

Means for Passage Comprehension Scores

Passage		Learning Disabled	Normally Achieving Eighth Graders	Normally Achieving Fifth Graders	Row Mean
Halloween					
PK	Yes	4.80 (n = 15)	5.00 (n = 16)	4.94 (n = 16)	4.91
	No	5.00 (n = 1)	0.00 (n = 0)	0.00 (n = 0)	5.00
Column Mean		4.81	5.00	4.94	
Christmas					
PK	Yes	4.60 (n = 15)	4.88 (n = 16)	4.38 (n = 16)	4.62
	No	5.00 (n = 1)	0.00 (n = 0)	0.00 (n = 0)	5.00
Column Mean		4.63	4.88	4.38	
Baseball					
PK	Yes	4.73 (n = 15)	4.88 (n = 16)	4.67 (n = 15)	4.76
	No	5.00 (n = 1)	0.00 (n = 0)	5.00 (n = 1)	5.00
Column Mean		4.75	4.88	4.69	
Mardi Gras					
PK	Yes	4.81 (n = 16)	5.00 (n = 16)	4.63 (n = 16)	4.81
	No	0.00 (n = 0)	0.00 (n = 0)	0.00 (n = 0)	0.00
Column Mean		4.81	5.00	4.63	
Beach					
PK	Yes	4.47 (n = 15)	4.81 (n = 16)	4.88 (n = 16)	4.72
	No	4.00 (n = 1)	0.00 (n = 0)	0.00 (n = 0)	4.00
Column Mean		4.44	4.81	4.88	
Amusement Park					
PK	Yes	4.29 (n = 14)	4.93 (n = 15)	4.31 (n = 16)	4.51
	No	5.00 (n = 2)	5.00 (n = 1)	0.00 (n = 0)	5.00
Column Mean		4.38	4.94	4.31	
McDonald's					
PK	Yes	3.87 (n = 15)	4.75 (n = 16)	3.81 (n = 16)	4.15
	No	5.00 (n = 1)	0.00 (n = 0)	0.00 (n = 0)	5.00
Column Mean		3.94	4.75	3.81	
French Quarter					
PK	Yes	3.93 (n = 14)	4.43 (n = 14)	3.50 (n = 14)	3.95
	No	4.00 (n = 2)	4.00 (n = 2)	4.50 (n = 2)	4.17
Column Mean		3.94	4.38	3.63	
Maple Sugar					
PK	Yes	2.00 (n = 4)	0.00 (n = 0)	2.00 (n = 3)	2.00
	No	1.83 (n = 12)	3.13 (n = 10)	2.31 (n = 13)	2.49
Column Mean		1.88	3.13	2.25	
Orthodox Baptism					
PK	Yes	2.00 (n = 2)	0.00 (n = 0)	1.67 (n = 3)	1.80
	No	2.14 (n = 14)	3.81 (n = 16)	2.38 (n = 13)	2.84
Column Mean		2.13	3.81	2.25	
Forty Day Memorial					
PK	Yes	1.67 (n = 3)	2.00 (n = 2)	0.00 (n = 0)	1.80
	No	1.38 (n = 13)	1.71 (n = 14)	1.38 (n = 16)	1.49
Column Mean		1.44	1.75	1.38	

<u>Steel Mill</u>					
PK	Yes	2.83 (n = 6)	3.00 (n = 1)	1.00 (n = 1)	2.63
	No	2.50 (n = 10)	2.33 (n = 15)	2.33 (n = 15)	2.38
Column Mean		2.63	2.38	2.25	
<u>Boat Trip Rhine River</u>					
PK	Yes	1.00 (n = 2)	1.00 (n = 1)	0.33 (n = 6)	0.56
	No	0.79 (n = 14)	1.53 (n = 15)	1.20 (n = 10)	1.18
Column Mean		0.81	1.50	0.88	
<u>Greek Independence Day</u>					
PK	Yes	2.00 (n = 1)	0.00 (n = 0)	2.00 (n = 1)	2.00
	No	2.07 (n = 15)	2.69 (n = 16)	1.67 (n = 15)	2.15
Column Mean		2.06	2.69	1.69	
<u>Orthodox Easter</u>					
PK	Yes	2.00 (n = 3)	0.00 (n = 0)	2.00 (n = 2)	2.00
	No	1.46 (n = 13)	2.13 (n = 16)	1.57 (n = 14)	1.74
Column Mean		1.56	2.13	1.63	
<u>Name Day</u>					
PK	Yes	2.00 (n = 1)	0.00 (n = 0)	0.00 (n = 0)	2.00
	No	0.67 (n = 15)	0.81 (n = 16)	0.56 (n = 16)	0.68
Column Mean		0.75	0.81	0.56	